



Farm River

Watershed Summary

WATERSHED DESCRIPTION AND MAPS

The Farm River watershed covers an area of approximately 16,359 acres in the southern coastal area of Connecticut (Figure 1). There are several municipalities located at least partially in the watershed, including the Towns of Wallingford, North Branford, Branford, and East Haven.

The Farm River watershed includes two segments impaired for recreation due to elevated bacteria levels. These segments were assessed by Connecticut Department of Energy and Environmental Protection (CT DEEP) and included in the CT 2010 303(d) list of impaired waterbodies. One segment in the watershed is currently unassessed as of the writing of this document. This does not suggest that there are no issues on this segment, but indicates a lack of current data to evaluate the segment as part of the assessment process. An excerpt of the Integrated Water Quality Report is included in Table 1 to show the status of other waterbodies in the watershed (CTDEEP, 2010).

The Farm River (Segment 2) (CT5112-00_02) begins at the outlet of Pages Mill Pond dam, upstream of the Mill Road Crossing in North Bradford, and ends where Burrs Brook enters the Farm River just downstream of the Route 80 crossing (Figure 2). Segment 2 is 1.24 miles long and is located entirely in the Town of North Branford. The Farm River (Segment 1) (CT5112-00_01) begins where Burrs Brook enters the Farm River, flows west to the intersection of Routes 17 and 22, flows south through East Haven, and ends downstream of the Main Street (Route 100) crossing in downtown East Haven. Segment 1 is 6.14 miles long and is located within the Towns of North Branford and East Haven.

The impaired segments of the Farm River have different water quality classifications. The Farm River (Segment 1) has a classification of A, while the Farm River (Segment 2) has a classification of AA. Designated uses for the Farm River (Segment 1) include potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. Designated uses for the Farm River (Segment 2) include existing or proposed drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, navigation, and industrial and agricultural water supply. Both segments are impaired due to elevated bacteria concentrations, affecting

Impaired Segment Facts

Impaired Segments:

1. Farm River (Segment 1)
CT5112-00_01
2. Farm River (Segment 2)
CT5112-00_02

Municipalities: East Haven, North Branford

Impaired Segment Length (miles): Segment 1 (6.14); Segment 2 (1.24)

Water Quality Classifications:
Segment 1 (A); Segment 2 (AA)

Designated Use Impairment:
Recreation

Sub-regional Basin Name and Code: Farm River, 5112

Regional Basin: South Central Western Complex

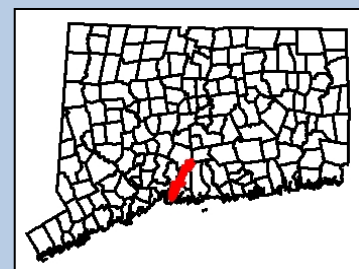
Major Basin: South Central Coast

Watershed Area (acres): 16,359

MS4 Applicable? Yes

Applicable Season: Recreation Season (May 1 to September 30)

Figure 1: Watershed location in Connecticut

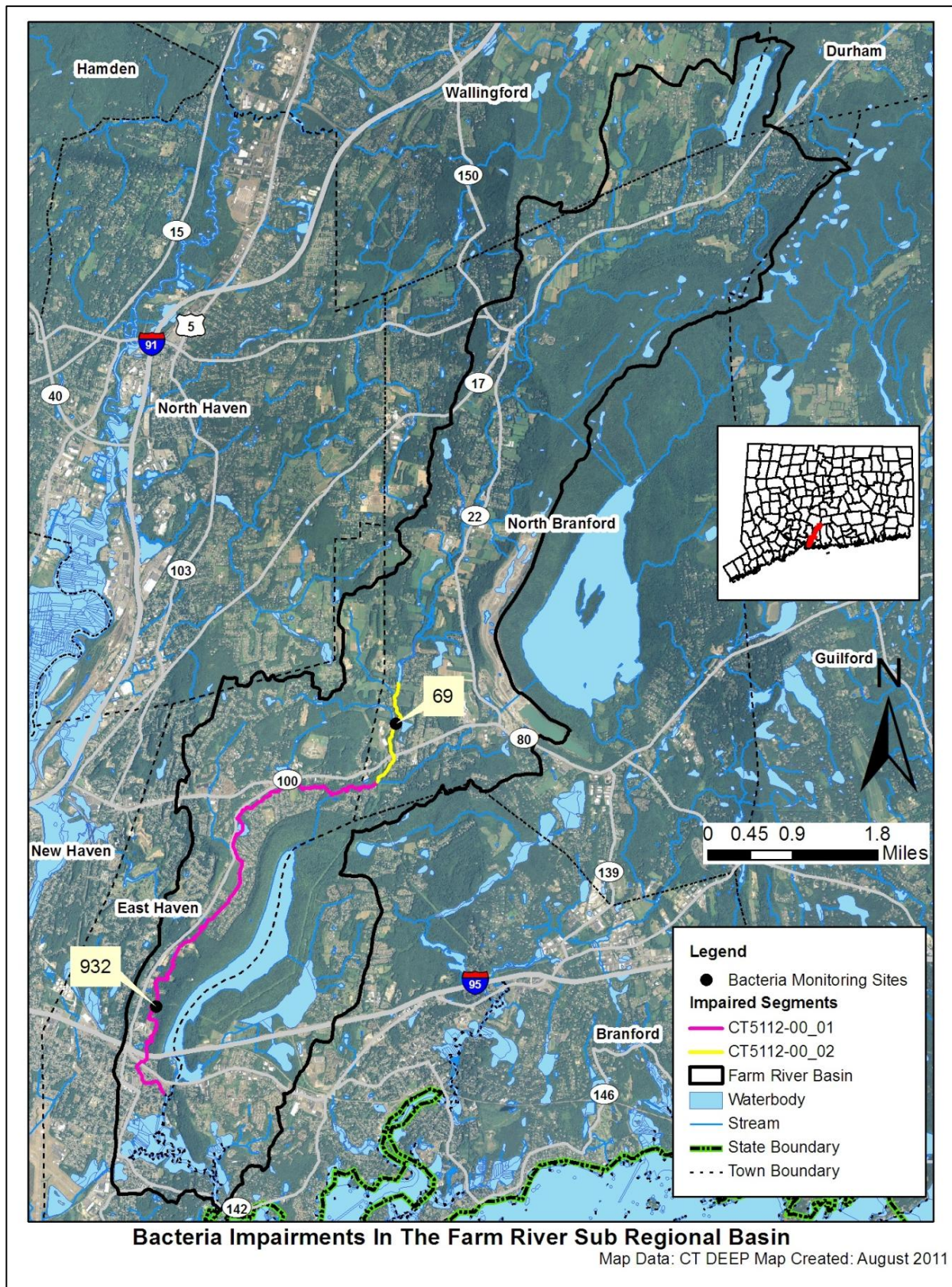


the designated use of recreation. As there are no designated beaches on these segments, the specific recreation impairment is for non-designated swimming and other water contact related activities.

Table 1: Impaired segment and nearby waterbodies from the Connecticut 2010 Integrated Water Quality Report

Waterbody ID	Waterbody Name	Location	Miles	Aquatic Life	Recreation	Fish Consumption
CT5112-00_01	Farm River (East Haven)-01	From saltwater limit at marsh (just DS of Main Street Annex. crossing, southwest of Lake Saltonstall outflow), East Haven, US (parallel to lake, around west side) to confluence with Burrs Brook (DS of Route 80 crossing), North Branford.	6.14	NOT	NOT	FULL
CT5112-00_02	Farm River (East Haven)-02	From confluence with Burrs Brook (DS of Route 80 crossing), US to Pages Mill Pond outlet dam, US side of Mill Road crossing, North Branford.	1.24	NOT	NOT	FULL
CT5112-00_03	Farm River (East Haven)-03	From Pages Mill Pond inlet, US to headwaters (just US of Hyla Lane crossing, near Middletown Avenue (Route 17) are), North Branford.	8.87	U	U	FULL
Shaded cells indicate impaired segment addressed in this TMDL FULL = Designated Use Fully Supported NOT = Designated Use Not Supported U = Unassessed						

Figure 2: GIS map featuring general information of the Farm River watershed at the sub-regional level



Land Use

Existing land use can affect the water quality of waterbodies within a watershed (USEPA, 2011c). Natural processes, such as soil infiltration of stormwater and plant uptake of water and nutrients, can occur in undeveloped portions of the watershed. As impervious surfaces (such as rooftops, roads, and sidewalks) increase within the watershed landscape from commercial, residential, and industrial development, the amount of stormwater runoff to waterbodies also increases. These waterbodies are negatively affected as increased pollutants from nutrients and bacteria from failing and insufficient septic systems, oil and grease from automobiles, and sediment from construction activities become entrained in this runoff. Agricultural land use activities, such as fertilizer application and manure from livestock, can also increase pollutants in nearby waterbodies (USEPA, 2011c).

As shown in Figures 3 and 4, the Farm River watershed consists of 42% forest, 38% urban area, 11% agriculture, and 8% water. Portions of the watershed in East Haven, particularly surrounding the Farm River (Segment 1), are characterized by urban land use. There are several large agricultural operations surrounding the Farm River near the beginning of Segment 2 in North Branford. While much of the northern portion of the watershed upstream of the impaired segments is intermixed with forest, urban, and agricultural land uses, nearly all the land abutting both impaired segments is dominated by urban land use (Figure 4).

Figure 3: Land use within the Farm River watershed

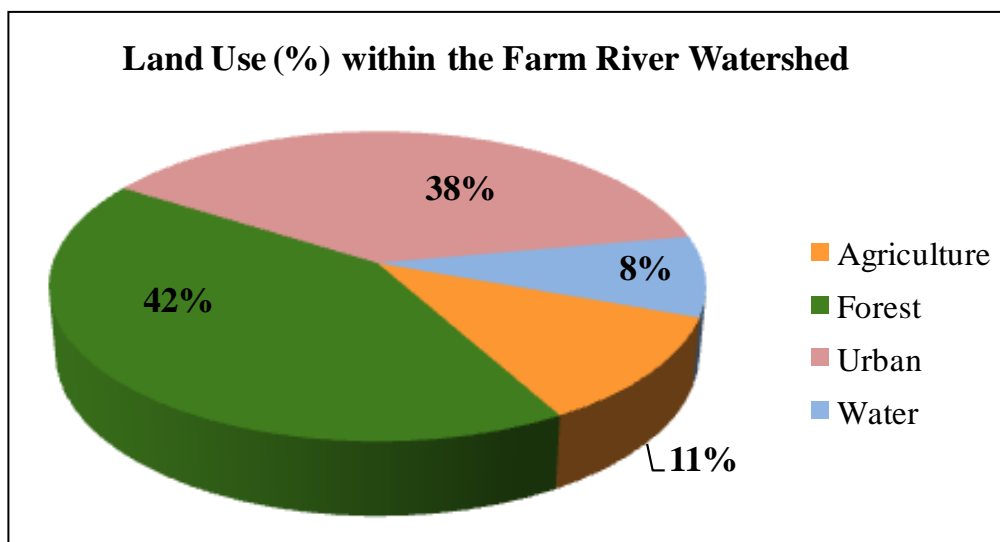
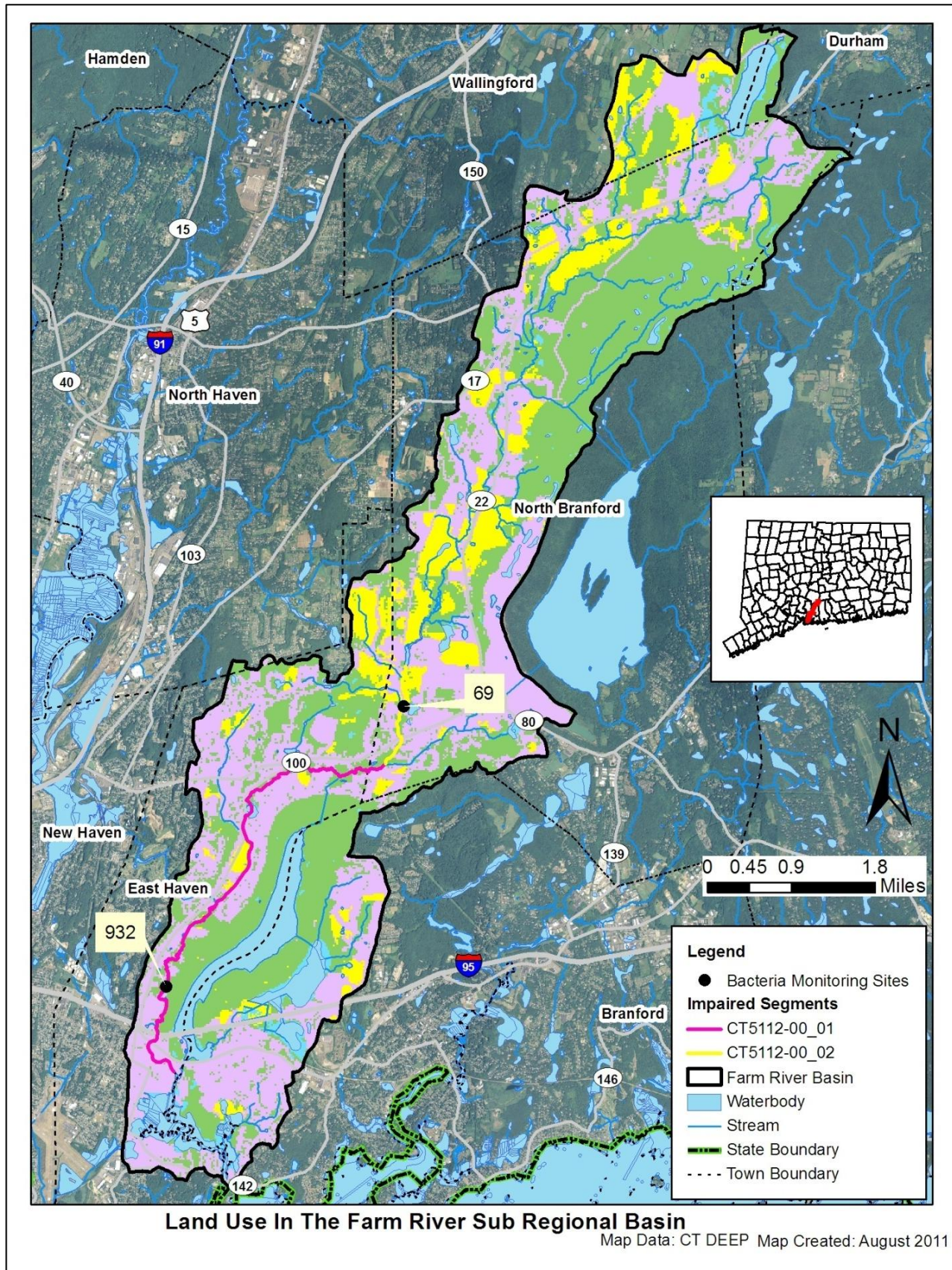


Figure 4: GIS map featuring land use for the Farm River watershed at the sub-regional level



WHY IS A TMDL NEEDED?

E. coli is the indicator bacteria used for comparison with the CT State criteria in the CT Water Quality Standards (WQS) (CTDEEP, 2011). All data results are from CT DEEP, USGS, Bureau of Aquaculture, or volunteer monitoring efforts at stations located on the impaired segments.

Table 2: Sampling station location description for the impaired segments in the Farm River watershed (stations organized downstream to upstream)

Waterbody ID	Waterbody Name	Station	Station Description	Municipality	Latitude	Longitude
CT5112-00_01	Farm River	932	off Gloria Place	East Haven	41.289472	-72.864147
CT5112-00_02	Farm River	69	Totoket Road	North Branford	41.333100	-72.815272

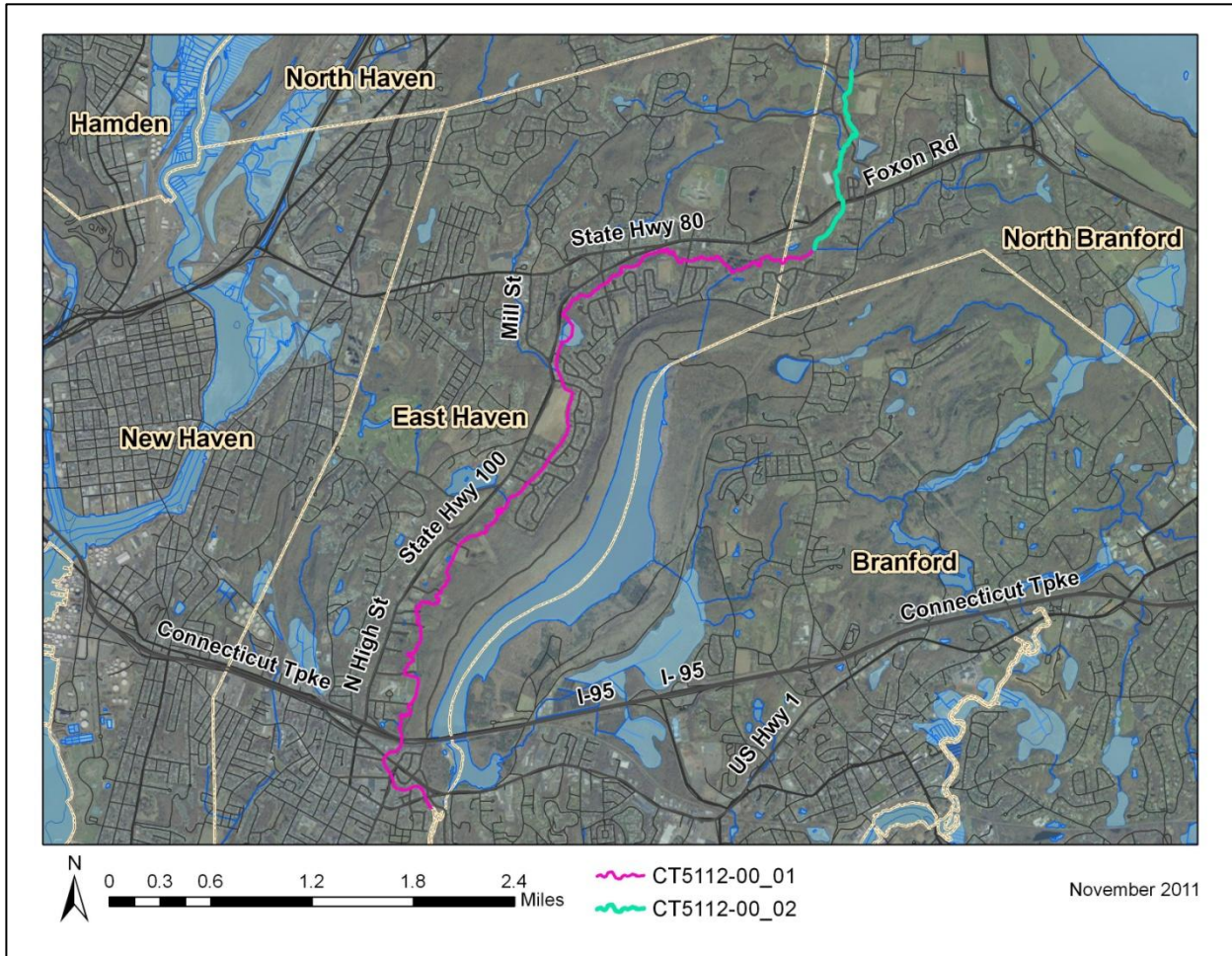
The Farm River (Segment 1) (CT5112-00_01) is a Class A freshwater river (Figure 5). Its applicable designated uses are potential drinking water supplies, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. The Farm River (Segment 2) (CT5112-00_02) is a Class AA freshwater river (Figure 5). Its applicable designated uses are an existing or proposed drinking water supply, habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. Water quality analyses were conducted using data from one sampling location on the Farm River (Segment 1) (Station 932), and one sampling location on the Farm River (Segment 2) (Station 69) (Table 2).

The water quality criteria for *E. coli*, along with bacteria sampling results from 1998, 2000, 2003, 2004 and 2006-2009, are presented in Tables 10 and 11 for the Farm River (Segments 1 and 2). For Segment 1, single sample values for Station 932 exceeded the WQS for *E. coli* in every sample year, except 2004. The annual geometric mean was calculated for Station 932 and exceeded the WQS for *E. coli* from 2006-2009. For Segment 2, single sample values exceeded the WQS for *E. coli* at Station 69 on all three sample dates. The annual geometric mean was calculated for Station 69 and exceeded the WQS for *E. coli* in 1998.

To aid in identifying possible bacteria sources, the geometric mean was also calculated for each station for wet-weather and dry-weather sampling days, where appropriate (Tables 10 and 11). For the Farm River (Segment 1), the geometric means during wet and dry-weather exceeded the WQS for *E. coli* at Station 932 with the geometric mean during wet-weather being four times greater than dry-weather. For the Farm River (Segment 2), the geometric mean during dry-weather exceeded the WQS for *E. coli* at Station 69. As there were no wet-weather samples taken at Station 69, a wet-weather geometric mean could not be calculated.

Due to the elevated bacteria measurements presented in Tables 10 and 11, the Farm River (Segments 1 and 2) did not meet CT's bacteria WQS, were identified as impaired, and were placed on the CT List of Waterbodies Not Meeting Water Quality Standards, also known as the CT 303(d) Impaired Waters List. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies to comply with State WQS.

Figure 5: Aerial map of the Farm River



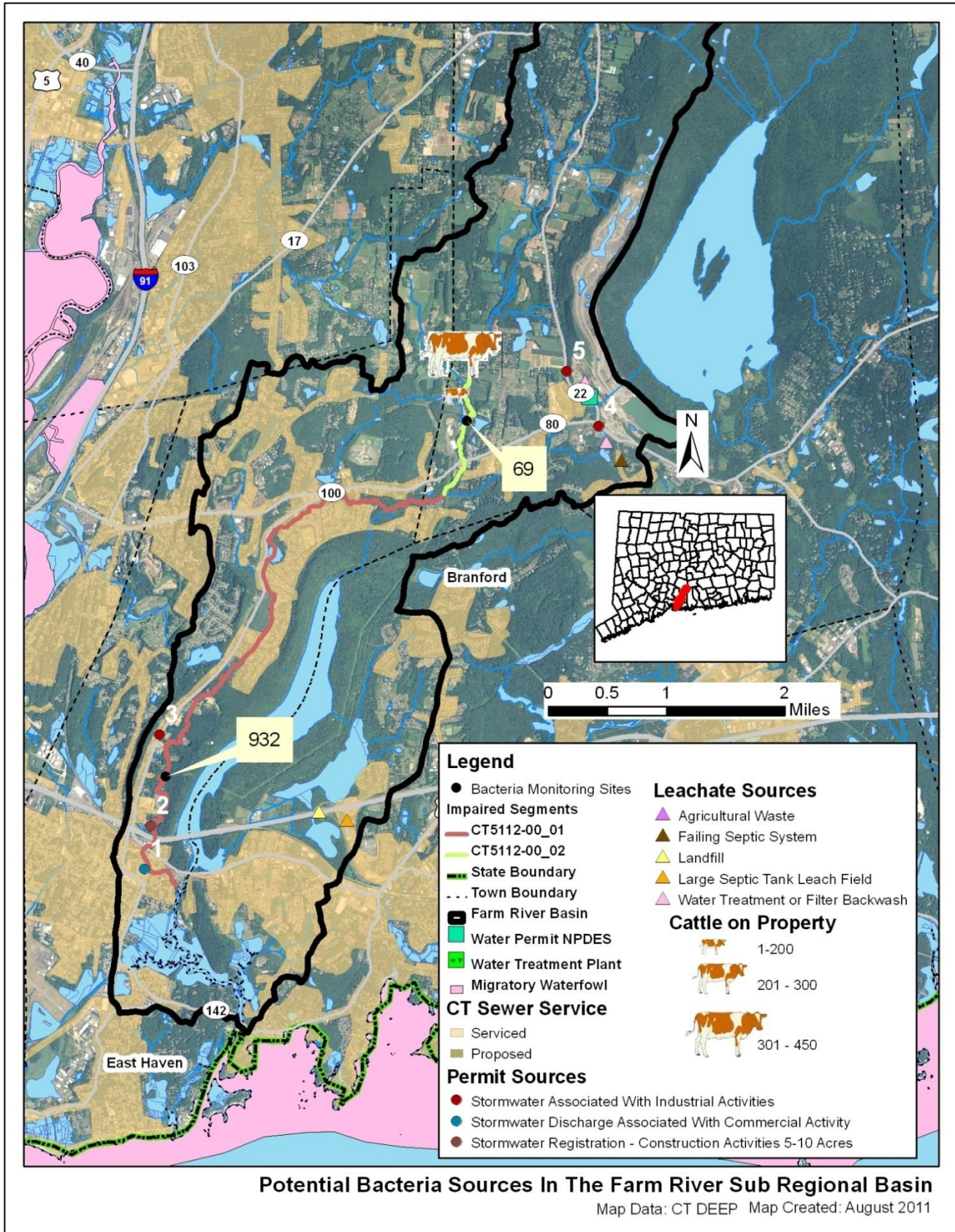
POTENTIAL BACTERIA SOURCES

Potential sources of indicator bacteria in a watershed include point and non-point sources, such as stormwater runoff, agriculture, sanitary sewer overflows (collection system failures), illicit discharges, and inappropriate discharges to the waterbody. Potential sources that have been tentatively identified in the watershed based on land use (Figures 3 and 4) and a collection of local information for the impaired waterbody is presented in Table 3 and Figure 6. However, the list of potential sources is general in nature and should not be considered comprehensive. There may be other sources not listed here that contribute to the observed water quality impairment in the study segments. Further monitoring and investigation will confirm listed sources and discover additional ones. Some segments in this watershed are currently listed as unassessed by CT DEEP procedures. This does not suggest that there are no potential issues on this segment, but indicates a lack of current data to evaluate the segment as part of the assessment process. For some segments, there are data from permitted sources, and CT DEEP recommends that any elevated concentrations found from those permitted sources be addressed through voluntary reduction measures. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement these TMDLs.

Table 3: Potential bacteria sources in the Farm River watershed

Impaired Segment	Permit Source	Illicit Discharge	CSO/SSO Issue	Failing Septic System	Agricultural Activity	Stormwater Runoff	Nuisance Wildlife/ Pets	Other
Farm River CT5112-00_01 (Segment 1)	x	x		x	x	x	x	x
Farm River CT5112-00_02 (Segment 2)	x	x		x	x	x	x	x

Figure 6: Potential sources in the Farm River watershed



The potential sources map for the impaired basin was developed after thorough analysis of available data sets. If information is not displayed in the map, then no sources were discovered during the analysis. The following is the list of potential sources that were evaluated: problems with migratory waterfowl, golf course locations, reservoirs, proposed and existing sewer service, cattle farms, poultry farms, permitted sources of bacteria loading (surface water discharge, MS4 permit, industrial stormwater, commercial stormwater, groundwater permits, and construction related stormwater), and leachate and discharge sources (agricultural waste, CSOs, failing septic systems, landfills, large septic tank leach fields, septage lagoons, sewage treatment plants, and water treatment or filter backwash).

Point Sources

Permitted sources within the watershed that could potentially contribute to the bacteria loading are identified in Table 4. This table includes permit types that may or may not be present in the impaired watershed. A list of active permits in the watershed is included in Table 5. Additional investigation and monitoring may reveal the presence of additional discharges in the watershed. Available effluent data from each of these permitted categories found within the watershed are compared to the CT State WQS for the appropriate receiving waterbody use and type. When available, bacteria data results from these permitted sources are listed in Tables 6 and 7.

Table 4: General categories list of other permitted discharges

Permit Code	Permit Description Type	Number in watershed
CT	Surface Water Discharges	0
GPL	Discharge of Swimming Pool Wastewater	0
GSC	Stormwater Discharge Associated with Commercial Activity	1
GSI	Stormwater Associated with Industrial Activity	3
GSM	Part B Municipal Stormwater MS4	2
GSN	Stormwater Registration – Construction	0
LF	Groundwater Permit (Landfill)	0
UI	Underground Injection	0

Permitted Sources

As shown in Table 5, there are multiple permitted discharges in the Farm River watershed. Bacteria data from 2000 for one of these industrial permitted facilities are included in Table 6. This data cannot be compared to a water quality standard as there is no recreation standard for fecal coliform. However, permitted discharges may be contributing bacteria to the impaired segments of the Farm River.

Since the MS4 permits are not targeted to a specific location, but the geographic area of the regulated municipality, there is no one accurate location on the map to display the location of these permits. One dot will be displayed at the geographic center of the municipality as a reference point. Sometimes this location falls outside of the targeted watershed and therefore the MS4 permit will not be displayed in the Potential Sources Map. Using the municipal border as a guideline will show which areas of an affected watershed are covered by an MS4 permit.

Table 5: Permitted facilities within the Farm River watershed

Town	Client	Permit ID	Permit Type	Site Name/Address	Map #
East Haven	State Of Connecticut Department Of Transportation	GSI000017	Stormwater Associated With Industrial Activities	East Haven Maintenance Facility	3
East Haven	Town of East Haven	GSM000093	Part B Municipal Stormwater MS4	East Haven, Town of	N/A
East Haven	The Stop & Shop Supermarket Company Llc	GSC000131	Stormwater Discharge Associated With Commercial Activity	Stop & Shop Store #692	1
North Branford	Tilcon Connecticut Inc.	GSI000577	Stormwater Associated With Industrial Activities	Tilcon Connecticut Inc.- North Branford	4
North Branford	Town Of North Branford	GSM000072	Part B Municipal Stormwater MS4	North Branford, Town of	N/A
NEW HAVEN	CITY OF NEW HAVEN (Permittee)	GSN001820	Stormwater Registration - Construction Activities 5-10 Acres	COMPREHENSIVE MODERIZATION EASTVIEW 4-34	2
North Branford	Town Of North Branford	GSI001874	Stormwater Associated With Industrial Activities	North Branford Department Of Public Works	5

Table 6: Industrial permits in the Farm River watershed and available fecal coliform data (colonies/100mL). The results cannot be compared to the water quality standard as there is no recreation standard for fecal coliform.

Town	Location	Permit Number	Receiving Water	Sample Location	Sample Date	Result
North Branford	Town of North Branford	GSI1874	Farm River	126100-1	02/28/00	0

Municipal Stormwater Permitted Sources

Per the EPA Phase II Stormwater rule all municipal storm sewer systems (MS4s) operators located within US Census Bureau Urbanized Areas (UAs) must be covered under MS4 permits regulated by the appropriate State agency. There is an EPA waiver process that municipalities can apply for to not participate in the MS4 program. In Connecticut, EPA has granted such waivers to 19 municipalities. All participating municipalities within UAs in Connecticut are currently regulated under MS4 permits by CT DEEP staff in the MS4 program.

The US Census Bureau defines a UA as a densely settled area that has a census population of at least 50,000. A UA generally consists of a geographic core of block groups or blocks that exceeds the 50,000 people threshold and has a population density of at least 1,000 people per square mile. The UA will also include adjacent block groups and blocks with at least 500 people per square mile. A UA consists of all or

part of one or more incorporated places and/or census designated places, and may include additional territory outside of any place. (67 FR 11663)

For the 2000 Census a new geographic entity was created to supplement the UA blocks of land. This created a block known as an Urban Cluster (UC) and is slightly different than the UA. The definition of a UC is a densely settled area that has a census population of 2,500 to 49,999. A UC generally consists of a geographic core of block groups or blocks that have a population density of at least 1,000 people per square mile, and adjacent block groups and blocks with at least 500 people per square mile. A UC consists of all or part of one or more incorporated places and/or census designated places; such a place(s) together with adjacent territory; or territory outside of any place. The major difference is the total population cap of 49,999 people for a UC compared to >50,000 people for a UA. (67 FR 11663)

While it is possible that CT DEEP will be expanding the reach of the MS4 program to include UC municipalities in the near future they are not currently under the permit. However, the GIS layers used to create the MS4 maps in this Statewide TMDL did include both UA and UC blocks. This factor creates some municipalities that appear to be within an MS4 program that are not currently regulated through an MS4 permit. This oversight can explain a municipality that is at least partially shaded grey in the maps and there are no active MS4 reporting materials or information included in the appropriate appendix. While these areas are not technically in the MS4 permit program, they are still considered urban by the cluster definition above and are likely to contribute similar stormwater discharges to affected waterbodies covered in this TMDL.

As previously noted, EPA can grant a waiver to a municipality to preclude their inclusion in the MS4 permit program. One reason a waiver could be granted is a municipality with a total population less than 1000 people, even if the municipality was located in a UA. There are 19 municipalities in Connecticut that have received waivers, this list is: Andover, Bozrah, Canterbury, Coventry, East Hampton, Franklin, Haddam, Killingworth, Litchfield, Lyme, New Hartford, Plainfield, Preston, Salem, Sherman, Sprague, Stafford, Washington, and Woodstock. There will be no MS4 reporting documents from these towns even if they are displayed in an MS4 area in the maps of this document.

The list of US Census UCs is defined by geographic regions and is named for those regions, not necessarily by following municipal borders. In Connecticut, the list of UCs includes blocks in the following Census Bureau regions: Colchester, Danielson, Lake Pocotopaug, Plainfield, Stafford, Storrs, Torrington, Willimantic, Winsted, and the border area with Westerly, RI (67 FR 11663). Any MS4 maps showing these municipalities may show grey areas that are not currently regulated by the CT DEEP MS4 permit program.

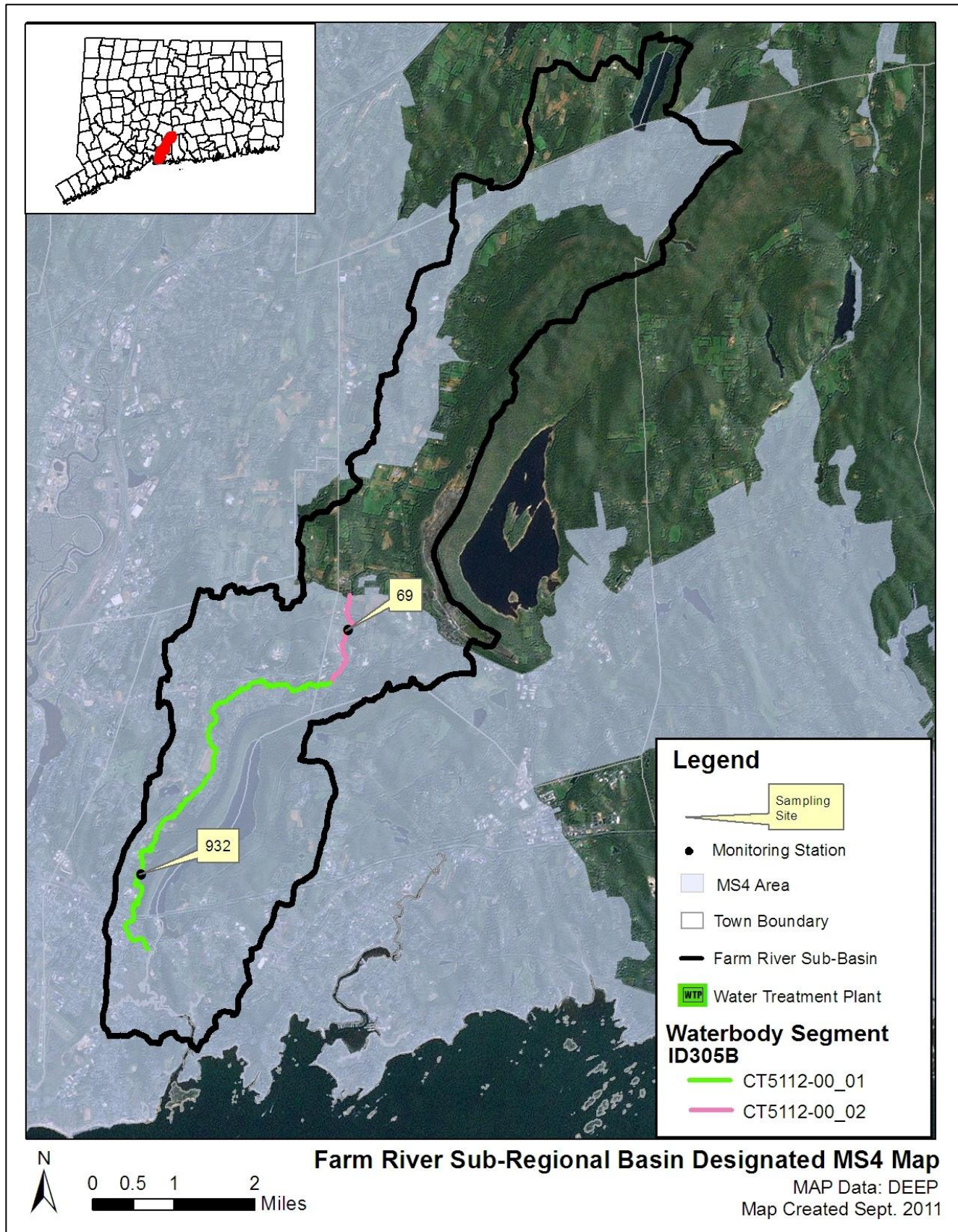
The Towns of East Haven and North Branford both have designated urban areas, as defined by the U.S. Census Bureau, and are required to comply with the General Permit for the Discharge of Stormwater from Small Municipal Storm Sewer Systems (MS4 permit) issued by the Connecticut Department of Energy and Environmental Protection (DEEP) (Figure 7). This general permit is only applicable to municipalities that are identified in Appendix A of the MS4 permit that contain designated urban areas and discharge stormwater via a separate storm sewer system to surface waters of the State. The permit required municipalities to develop a Stormwater Management Plan (SMP) to reduce the discharge of pollutants as well as to protect water quality. The MS4 permit is discussed further in the "TMDL Implementation Guidance" section of the core TMDL document. Additional information regarding stormwater management and the MS4 permit can be obtained on CTDEEP's website (http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325702&depNav_GID=1654).

Multiple MS4 outfalls have been sampled for *E. coli* bacteria in the watershed (Table 7). There were two outfalls sampled in North Branford in 2006, 2007, and 2010. All samples exceeded the single sample water quality standard of 410 colonies/100 mL.

Table 7: List of MS4 sample locations and *E. coli* (colonies/100 mL) results in the Farm River watershed

Town	Location	MS4 Type	Receiving Waters	Sample Date	Result
North Branford	Ardsley Ave	Commercial	Farm River	08/15/06	21,000
North Branford	Ardsley Ave	Commercial	Farm River	11/02/06	>8000
North Branford	Ardsley Ave	Commercial	Farm River	12/01/06	2,000
North Branford	Ardsley Ave	Commercial	Farm River	09/11/07	10,000
North Branford	Ardsley Ave (C-2)	Commercial	Farm River	10/27/10	2,000
North Branford	Ardsley Ave (C-2)	Commercial	Farm River	11/04/10	2,500
Shaded cells indicate an exceedance of single-sample based water quality criteria (410 colonies/100 mL)					

Figure 7: MS4 areas of the Farm River watershed



Non-point Sources

Non-point source pollution (NPS) comes from many diffuse sources and is more difficult to identify and control. NPS pollution is often associated with land-use practices. Examples of NPS that can contribute bacteria to surface waters include insufficient septic systems, pet and wildlife waste, agriculture, and contact recreation (swimming or wading). Potential sources of NPS within the Farm River watershed are described below.

Stormwater Runoff from Developed Areas

Approximately 38% of the watershed is considered urban, and much of that area is concentrated around the impaired segments in the Towns of East Haven and North Branford (Figures 4 and 9). Urban areas are often characterized by impervious cover, or surface areas such as roofs and roads that force water to run off land surfaces rather than infiltrate into the soil. Studies have shown a link between increasing impervious cover and degrading water quality conditions in a watershed (CWP, 2003). In one study, researchers correlated the amount of fecal coliform to the percent of impervious cover in a watershed (Mallin *et al.*, 2000).

Approximately 44% of the Farm River watershed is characterized by 0-6% impervious cover, 25% is characterized by 7-11% impervious cover, 8% is characterized by 12-15% impervious cover, and 23% is characterized by >16% impervious cover (Figure 8). Nearly the entire length of the Farm River (Segment 1) is surrounded by >16% impervious cover, and the Farm River (Segment 2) is surrounded by >7% impervious cover (Figure 9).

A high geometric mean for bacteria during wet-weather may indicate that stormwater runoff is contributing pollutants to nearby waterbodies. As shown in Table 10, the geometric mean for *E. coli* exceeded the WQS at Station 932 during wet-weather. This high value and the close proximity of urban areas to the Farm River (Segment 1) suggest that stormwater runoff is likely contributing bacteria to the Farm River.

Figure 8: Range of impervious cover (%) in the Farm River watershed

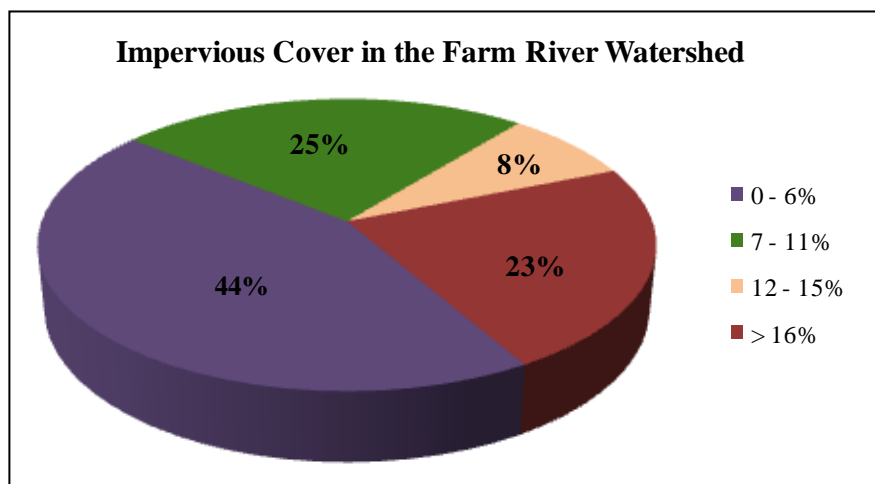
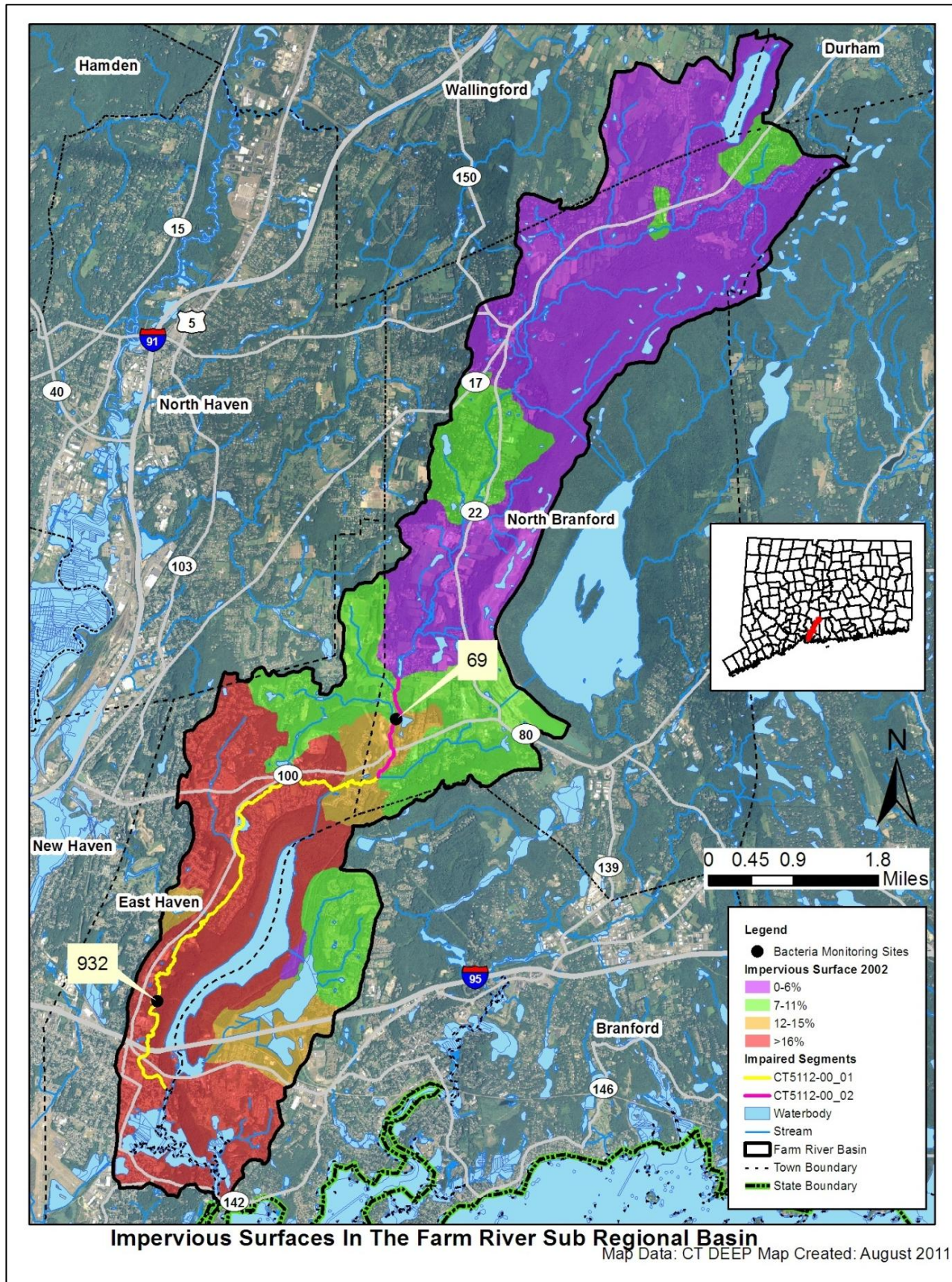


Figure 9: Impervious cover (%) for the Farm River sub-regional watershed



Agricultural Activities

Agricultural operations are an important economic activity and landscape feature in many areas of the State. Runoff from agricultural fields may contain pollutants such as bacteria and nutrients (USEPA, 2011a). This runoff can include pollutants from farm practices such as storing manure, allowing livestock to wade in nearby waterbodies, applying fertilizer, and reducing the width of vegetated buffer along the shoreline. Agricultural land use makes up 11% of the Farm River watershed. There are multiple agricultural operations along the Farm River (Segment 2) in North Branford, particularly near Pages Mill Pond and the intersection of Mill Road and Totoket Road.

Several large cattle farms with 300-450 cattle and an agricultural waste leachate were documented as potential sources of bacterial contamination near the Farm River (Segment 2) (Figure 6). There are also several agricultural operations along the Farm River (Segment 1) in East Haven, particularly along North High Street (Route 100), Hellstrom Road, and the intersection of River Road and Foxon Road (Route 80). These agricultural areas may potentially carry pollutants, including bacteria, into the impaired segments of the Farm River.

Insufficient Septic Systems and Illicit Discharges

As shown in Figure 6, some residents surrounding the impaired segments of the Farm River in North Branford and East Haven, particularly along the Farm River (Segment 2), rely on onsite wastewater treatment systems, such as septic systems to treat their waste. Insufficient or failing septic systems can be significant sources of bacteria by allowing raw waste to reach surface waters. In Connecticut, local health directors or health districts are responsible for keeping track of any reported insufficient or failing septic systems in a specific municipality. The Towns of North Branford and East Haven are part of the greater East Shore District Health Department (<http://esdhd.org/>), which serves the towns of East Haven, North Branford, and Branford.

Many residents along the Farm River rely on sanitary sewer, particularly along portions of the Farm River (Segment 1). Sewer system leaks and other illicit discharges located within the watershed may be contributing bacteria to these waterbodies.

Wildlife and Domestic Animal Waste

Wildlife and domestic animals within the Farm River watershed also represent a potential source of bacteria. With the construction of roads and drainage systems, these wastes may no longer be retained on the landscape, but instead may be conveyed via stormwater to the nearest surface water. These physical land alterations can exacerbate the impact of natural sources on water quality (USEPA, 2001).

Geese and other waterfowl are known to congregate in open areas, including recreational fields, agricultural cropfields, and golf courses. Kennedy Memorial Field and the Alling Memorial Golf Course near the Farm River (Segment 1) are recreational areas with turf grass that serve as potential places for geese and other waterfowl to congregate. In addition to creating a nuisance, large numbers of geese can also create unsanitary conditions on the grassed areas and cause water quality problems due to bacterial contamination associated with their droppings. Large populations of geese can also lead to habitat destruction as a result of overgrazing on wetland and riparian plants.

Dense residential development surrounds much of the Farm River (Segment 1) in East Haven, and the northern portion of the Farm River (Segment 2) near Pages Mill Pond in North Branford (Figure 5). When not properly disposed, waste from domestic animals, such as dogs, can enter surface waters directly or

through stormwater infrastructure. Therefore, domestic animal waste may be contributing to bacteria concentrations in the impaired segments of the Farm River.

Additional Sources

There may be other sources not listed here or identified in Figure 6 that contribute to the observed water quality impairment in Segments 1 and 2 of the Farm River. Further monitoring and investigation will confirm listed sources and discover additional ones. More detailed evaluation of potential sources is expected to become available as activities are conducted to implement this TMDL.

Land Use/Landscape

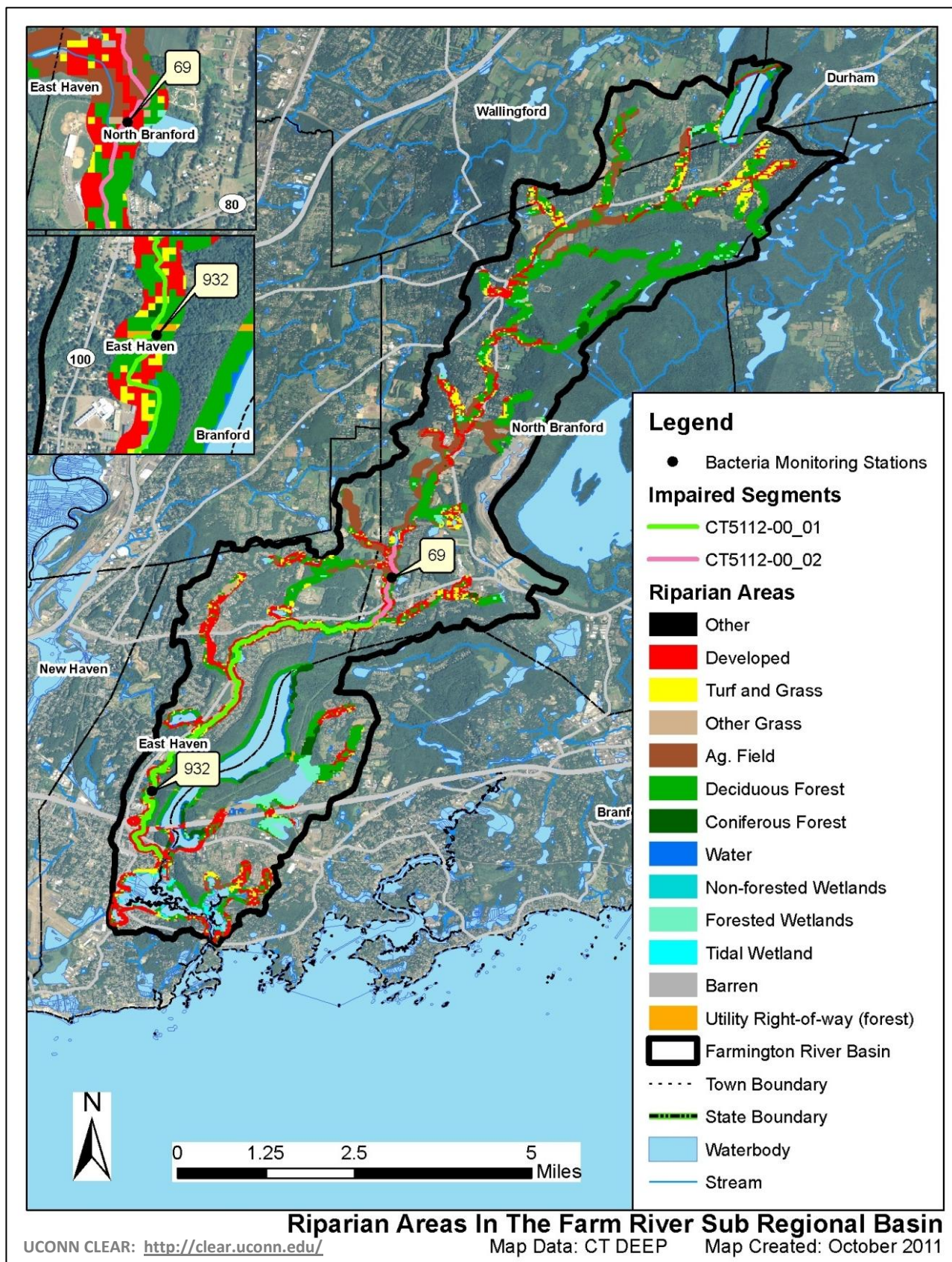
Riparian Buffer Zones

The riparian buffer zone is the area of land located immediately adjacent to streams, lakes, or other surface waters. The boundary of the riparian zone and the adjoining uplands is gradual and not always well-defined. However, riparian zones differ from uplands because of high levels of soil moisture, frequent flooding, and the unique assemblage of plant and animal communities found there. Through the interaction of their soils, hydrology, and vegetation, natural riparian areas influence water quality as contaminants are taken up into plant tissues, adsorbed onto soil particles, or modified by soil organisms. Any change to the natural riparian buffer zone can reduce the effectiveness of the natural buffer and has the potential to contribute to water quality impairment (USEPA, 2011b).

The CLEAR program at UCONN has created streamside buffer layers for the entire State of Connecticut (<http://clear.uconn.edu/>), which have been used in this TMDL. Analyzing this information can reveal potential sources and implementation opportunities at a localized level. The land use directly adjacent to a waterbody can have direct impacts on water quality from surface runoff sources.

The riparian zone of the Farm River (Segment 1) is characterized by developed, turf grass, and forested land use (Figure 10). Much of the downstream riparian zone for the Farm River (Segment 2) is characterized by agricultural, developed, and forested land uses, while the majority of the upstream portion of Segment 2 is dominated by agricultural land. As previously mentioned, developed and agricultural areas are potential sources of bacterial contamination.

Figure 10: Riparian buffer zone information for the Farm River watershed



CURRENT MANAGEMENT ACTIVITIES

The Towns of North Branford and East Haven have developed and implemented some programs to protect water quality from bacterial contamination. As indicated previously, the portion of the watershed surrounding the impaired segment is regulated under the MS4 program. The MS4 General Permit is required for any municipality with urbanized areas that initiates, creates, originates or maintains any discharge of stormwater from a storm sewer system to waters of the State. The MS4 permit requires towns to design a Stormwater Management Plan (SMP) to reduce the discharge of pollutants in stormwater to improve water quality. The plan must address the following 6 minimum measures:

1. Public Education and Outreach.
2. Public Involvement/Participation.
3. Illicit discharge detection and elimination.
4. Construction site stormwater runoff control.
5. Post-construction stormwater management in the new development and redevelopment.
6. Pollution prevention/good housekeeping for municipal operations.

Each municipality is also required to submit an annual update outlining the steps they are taking to meet the six minimum measures. All updates that address bacterial contamination in the watershed are summarized in Tables 8 and 9.

Table 8: Summary of MS4 requirement updates related to the reduction of bacterial contamination from East Haven, CT (Permit # GSM000093)

Minimum Measure	East Haven 2006 Annual Report Update
Public Outreach and Education	1) Made copies of "Caring for Your Septic System" available in the Planning Department.
Public Involvement and Participation	1) Coordinated storm drain stenciling with local Boy Scout Troops.
	2) Sponsored stream and river clean-ups with particular attention paid to the Farm River.
Illicit Discharge Detection and Elimination	1) Educated residents and businesses on types of illicit discharges.
	2) Sampled 25% of outfalls where dry weather discharges were identified and attempted to identify the source of potential illicit discharges.
	3) Maintained a log and map location of reports of illicit discharges and illegal dumping that are called into the Engineering Department.
Construction Site Stormwater Runoff Control	No updates
Post Construction Stormwater management	1) Coordinated a NEMO presentation for Town Staff, the Town Council, and Land Use Commission.
Pollution Prevention and Good Housekeeping	1) Inspected 1/3 of all the catch basins in town and developed a summary of the priority areas for catch basin cleaning and street sweeping.
	2) Inspected Stormwater outfalls for the southern half of town and prepared a plan to inspect and map Stormwater outfalls in the northern half of town.

Table 9: Summary of MS4 requirement updates related to the reduction of bacterial contamination from North Branford, CT (Permit # GSM000072)

Minimum Measure	North Branford 2010 Annual Report Update
Public Outreach and Education	1) Distributed stormwater brochures and septic system maintenance brochures.
Public Involvement and Participation	1) Coordinated an Earth Day clean up.
	2) Continued various educational programs for K-12 students aimed at water pollution and prevention.
Illicit Discharge Detection and Elimination	1) Worked with RWA and the East Shore Health District to continue inspecting, identifying, and correcting illicit discharges in town.
	2) Inspected 10 outfalls and rebuilt three.
	3) Attended an in-house training session on the approved methods for identifying, inspecting, documenting, and cleaning outfalls.
	4) Worked with the East Shore Health District to perform 90 site investigations on septic systems and helped with sewage system repairs on 30 sites.
Construction Site Stormwater Runoff Control	1) Inspected 25 construction sites by Town staff.
Post Construction Stormwater management	No updates
Pollution Prevention and Good Housekeeping	1) Cleaned 110 catch basins during 2010.
	2) Swept approximately 80 miles (the entire town) of town roads, and all town-owned parking lots.
	3) Replaced 560 linear feet of storm sewer piping and flushed 1400 linear feet to improve system performance.

RECOMMENDED NEXT STEPS

As shown above, the Towns of North Branford East Haven have developed and implemented programs to protect water quality from bacterial contamination. Future mitigative activities are necessary to ensure the long-term protection of the Farm River and have been prioritized below.

1) Identify areas along developed portions of the Farm River to implement Best Management Practices (BMPs) to control stormwater runoff.

As noted previously, the Towns of East Haven and North Branford within the Farm River watershed are MS4 communities regulated by the MS4 program. Since 38% of the watershed is considered urban with high impervious cover estimates, stormwater runoff may be contributing bacteria to these waterbodies. To identify specific areas that are contributing bacteria to the impaired segments of the Farm River, the municipalities should conduct wet-weather sampling at stormwater outfalls that discharge directly to the Farm River. To treat stormwater runoff, the towns should also identify areas along the more developed sections of the Farm River, particularly along the impaired segments, to install BMPs designed to encourage stormwater to infiltrate into the ground before entering these waterbodies. These BMPs would disconnect impervious areas and reduce pollutant loads to the Farm River's impaired segments. More detailed information and BMP recommendations can be found in the core TMDL document.

2) Ensure there are sufficient buffers on agricultural lands along the Farm River and its tributaries.

If not already in place, agricultural producers should work with the CT Department of Agriculture and the U.S. Department of Agriculture Natural Resources Conservation Service to develop conservation plans for their farming activities within the watershed. These plans should focus on ensuring that there are sufficient stream buffers, that fencing exists to restrict livestock and horse access to streams and wetlands, and that animal waste handling, disposal, and other appropriate Best Management Practices (BMPs) are in place. Particular attention should be paid to the agricultural operations near the Farm River's impaired segments.

3) Develop a system to monitor septic systems.

Many residents of the Farm River watershed rely on septic systems. North Branford has already implemented an inspection program for 90 septic system sites. North Branford and East Haven should continue to develop programs that ensure existing septic systems are properly operated and maintained. For instance, communities can create an inventory of existing septic systems through mandatory inspections. Inspections help encourage proper maintenance and identify failed and sub-standard systems. Policies that govern the eventual replacement of the sub-standard systems within a reasonable timeframe could be adopted. Towns can also develop programs to assist citizens with the replacement and repair of older and failing systems.

4) Implement a program to evaluate the sanitary sewer system.

Some areas around the Farm River rely on a municipal sewer system (Figure 6). Since the sanitary sewer surrounds much of the Farm River (Segment 1) and a portion of Segment 2, ensuring there are no leaks or overflows from the sanitary sewer in these areas should be made a priority. North Branford has already made efforts in identifying and remediating illicit discharges, and has inspected 10 outfalls, rebuilt 3 outfalls, and repaired the sewage line at 30 sites. East Haven has sampled 25% of outfalls where dry-weather discharges were detected, and maintains a map location of identified illicit discharges. It is important for East Haven and North Branford to continue developing programs that evaluate their sanitary sewer and reduce leaks and overflows, especially in the areas around the Farm River's impaired segments.

5) Evaluate municipal education and outreach programs regarding animal waste.

Any education and outreach programs within East Haven and North Branford should highlight the importance of not feeding waterfowl and wildlife, and managing waste from dogs and other pets. Municipalities and residents can take measures to minimize waterfowl-related impacts such as allowing tall, coarse vegetation to grow in the riparian areas of the impaired segments of the Farm River that are frequented by waterfowl. Waterfowl, especially grazers like geese, prefer easy access to water. Maintaining an uncut vegetated buffer along the shore will make the habitat less desirable to geese and encourage migration. In addition, any educational program should emphasize that feeding waterfowl, such as ducks, geese, and swans may contribute to water quality impairments in the Farm River watershed, particularly in Segments 1 and 2, and can harm human health and the environment.

Animal wastes should be disposed away from any waterbody or storm drain system. BMPs effective at reducing the impact of animal waste on water quality include installing signage, providing pet waste receptacles in high-uses areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas.

6) Continue monitoring of permitted sources.

Although previous sampling of one permitted source discharge in North Branford did not show elevated levels of fecal coliform bacteria, bacteria from other permitted discharges in the watershed may still be a contributor of bacterial pollution to the Farm River. Further monitoring will provide information essential to better locate, understand, and reduce pollution sources. If any current monitoring is not done with appropriate bacterial indicator based on the receiving water, then a recommended change during the next permit reissuance is to include the appropriate indicator species. If facility monitoring indicates elevated bacteria, then implementation of permit required, and voluntary measures to identify and reduce sources of bacterial contamination at the facility are an additional recommendation. Regular monitoring should be established for all permitted sources to ensure compliance with permit requirements and to determine if current requirements are adequate or if additional measures are necessary for water quality protection.

Section 6(k) of the MS4 General Permit requires a municipality to modify their Stormwater Management Plan to implement the TMDL within four months of TMDL approval by EPA if stormwater within the municipality contributes pollutant(s) in excess of the allocation established by the TMDL. For discharges to impaired waterbodies, the municipality must assess and modify the six minimum measures of its plan, if necessary, to meet TMDL standards. Particular focus should be placed on the following plan components: public education, illicit discharge detection and elimination, stormwater structures cleaning, and the repair, upgrade, or retrofit of storm sewer structures. The goal of these modifications is to establish a program that improves water quality consistent with TMDL requirements. Modifications to the Stormwater Management Plan in response to TMDL development should be submitted to the Stormwater Program of DEEP for review and approval.

Table 7 details the appropriate bacteria criteria for use as waste load allocations established by this TMDL for use as water quality targets by permittees as permits are renewed and updated, within the Farm River watershed.

For any municipality subject to an MS4 permit and affected by a TMDL, the permit requires a modification of the SMP to include BMPs that address the included impairment. In the case of bacteria related impairments municipal BMPs could include: implementation or improvement to existing nuisance wildlife programs, septic system monitoring programs, any additional measures that can be added to the required illicit discharge detection and elimination (IDDE) programs, and increased street sweeping above

basic permit requirements. Any non-MS4 municipalities can implement these same types of initiatives in effort to reduce bacteria source loading to impaired waterways.

Any facilities that discharge non-MS4 regulated stormwater should update their Pollution Prevention Plan to reflect BMPs that can reduce bacteria loading to the receiving waterway. These BMPs could include nuisance wildlife control programs and any installations that increase surface infiltration to reduce overall stormwater volumes. Facilities that are regulated under the Commercial Activities Stormwater Permit should report any updates to their SMP in their summary documentation submitted to DEEP.

Table 7. Bacteria (e.coli) TMDLs, WLAs, and LAs for Recreational Use

		Instantaneous <i>E. coli</i> (#/100mL)						Geometric Mean <i>E. coli</i> (#/100mL)	
Class	Bacteria Source	WLA ⁶			LA ⁶			WLA ⁶	LA ⁶
	Recreational Use	1	2	3	1	2	3	All	All
A	Non-Stormwater NPDES	0	0	0				0	
	CSOs	0	0	0				0	
	SSOs	0	0	0				0	
	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	
	Stormwater (MS4s)	235 ⁷	410 ⁷	576 ⁷				126 ⁷	
	Stormwater (non-MS4)				235 ⁷	410 ⁷	576 ⁷		126 ⁷
	Wildlife direct discharge				235 ⁷	410 ⁷	576 ⁷		126 ⁷
	Human or domestic animal direct discharge ⁵				235	410	576		126
AA	Illicit sewer connection	0	0	0				0	
	Leaking sewer lines	0	0	0				0	
	Stormwater (MS4s)	235 ⁷	410 ⁷	576 ⁷				126 ⁷	
	Stormwater (non-MS4)				235 ⁷	410 ⁷	576 ⁷		126 ⁷
	Wildlife direct discharge				235 ⁷	410 ⁷	576 ⁷		126 ⁷
	Human or domestic animal direct discharge ⁵				235	410	576		126

- (1) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protections and the Department of Public Health. May 1989. Revised April 2003 and updated December 2008.
- (2) **Non-Designated Swimming.** Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.
- (3) **All Other Recreational Uses.**
- (4) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of sewage treatment plant effluents is not required consistent with Standard 23. (Class B surface waters located north of Interstate Highway I-95 and downstream of a sewage treatment plant providing seasonal disinfection May 1 through October 1, as authorized by the Commissioner.)
- (5) Human direct discharge = swimmers
- (6) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations
- (7) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP 2011a). Sections 2.2.2 and 6.2.7 of this Core Document deal with BMPs and delineating type of wildlife inputs.

BACTERIA DATA AND PERCENT REDUCTIONS TO MEET THE TMDL**Table 10: Farm River (Segment 1) Bacteria Data****Waterbody ID:** CT5112-00_01**Characteristics:** Freshwater, Class A, Potential Drinking Water Source, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply**Impairment:** Recreation (*E. coli* bacteria)**Water Quality Criteria for *E. coli*:**

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:Geometric Mean: **91%**Single Sample: **98%****Data:** 2003, 2004, and 2006-2009 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle**Single sample *E. coli* (colonies/100 mL) data from Station 932 on the Farm River (Segment 1) with annual geometric means calculated**

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
932	End of dirt road crossing off Gloria Place	4/28/2003	200	dry	321
932	End of dirt road crossing off Gloria Place	8/18/2003	1100	wet	
932	End of dirt road crossing off Gloria Place	11/4/2003	150	dry	
932	End of dirt road crossing off Gloria Place	2/19/2004	145 [†]	dry	NA
932	End of dirt road crossing off Gloria Place	6/1/2006	850 [†]	wet	1368* (91%)
932	End of dirt road crossing off Gloria Place	6/15/2006	1600	wet	
932	End of dirt road crossing off Gloria Place	6/21/2006	830	wet	
932	End of dirt road crossing off Gloria Place	6/29/2006	2200	wet	
932	End of dirt road crossing off Gloria Place	7/12/2006	690 [†]	wet	
932	End of dirt road crossing off Gloria Place	7/20/2006	24000* (98%)	wet	
932	End of dirt road crossing off Gloria Place	7/27/2006	710	dry	
932	End of dirt road crossing off Gloria Place	8/3/2006	10000	wet	
932	End of dirt road crossing off Gloria Place	8/10/2006	570	dry	
932	End of dirt road crossing off Gloria Place	8/17/2006	450	dry	
932	End of dirt road crossing off Gloria Place	8/24/2006	420	dry	

Single sample *E. coli* (colonies/100 mL) data from Station 932 on the Farm River (Segment 1) with annual geometric means calculated (continued)

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
932	End of dirt road crossing off Gloria Place	6/17/2007	370	dry	1005
932	End of dirt road crossing off Gloria Place	6/20/2007	520 [†]	wet	
932	End of dirt road crossing off Gloria Place	7/5/2007	7700 [†]	wet	
932	End of dirt road crossing off Gloria Place	7/12/2007	1900	dry	
932	End of dirt road crossing off Gloria Place	7/19/2007	3700	wet	
932	End of dirt road crossing off Gloria Place	7/26/2007	310	dry	
932	End of dirt road crossing off Gloria Place	8/8/2007	1050 [†]	wet	
932	End of dirt road crossing off Gloria Place	8/22/2007	2001 [†]	wet	
932	End of dirt road crossing off Gloria Place	9/10/2007	500	dry	
932	End of dirt road crossing off Gloria Place	9/20/2007	310	dry	
932	End of dirt road crossing off Gloria Place	6/2/2008	350	dry	596
932	End of dirt road crossing off Gloria Place	6/11/2008	700	dry	
932	End of dirt road crossing off Gloria Place	6/18/2008	1400	wet**	
932	End of dirt road crossing off Gloria Place	6/25/2008	730	wet**	
932	End of dirt road crossing off Gloria Place	7/2/2008	610	dry	
932	End of dirt road crossing off Gloria Place	7/9/2008	480	dry	
932	End of dirt road crossing off Gloria Place	7/17/2008	630	dry	
932	End of dirt road crossing off Gloria Place	7/30/2008	790	dry	
932	End of dirt road crossing off Gloria Place	8/5/2008	470	dry	
932	End of dirt road crossing off Gloria Place	8/13/2008	560	dry	
932	End of dirt road crossing off Gloria Place	8/20/2008	350	dry	
932	End of dirt road crossing off Gloria Place	6/17/2009	330	dry	432
932	End of dirt road crossing off Gloria Place	6/24/2009	280	wet	
932	End of dirt road crossing off Gloria Place	7/1/2009	240	dry	
932	End of dirt road crossing off Gloria Place	7/22/2009	20000	wet	
932	End of dirt road crossing off Gloria Place	8/5/2009	260	dry	
932	End of dirt road crossing off Gloria Place	8/12/2009	310	dry	
932	End of dirt road crossing off Gloria Place	8/19/2009	300	dry	
932	End of dirt road crossing off Gloria Place	9/3/2009	220	dry	
932	End of dirt road crossing off Gloria Place	9/9/2009	220	dry	

Shaded cells indicate an exceedance of water quality criteria

[†] Average of two duplicate samples

**** Weather conditions for selected data taken from Hartford because local station had missing data**

***Indicates single sample and geometric mean values used to calculate the percent reduction**

Wet and dry weather *E. coli* (colonies/100 mL) geometric mean values for Station 932 on the Farm River Segment 1

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
932	End of dirt road crossing off Gloria Place	2003, 2004, 2006-2009	17	28	715	1944	390
Shaded cells indicate an exceedance of water quality criteria Weather condition determined from rain gages at Tweed KMMK station in New Haven, CT and at Hartford Bradley International Airport							

Table 11: Farm River (Segment 2) Bacteria Data**Waterbody ID:** CT5112-00_02**Characteristics:** Freshwater, Class AA, Existing or Proposed Drinking Water Source, Habitat for Fish and other Aquatic Life and Wildlife, Recreation, and Industrial and Agricultural Water Supply**Impairment:** Recreation (*E. coli* bacteria)**Water Quality Criteria for *E. coli*:**

Geometric Mean: 126 colonies/100 mL

Single Sample: 410 colonies/100 mL

Percent Reduction to meet TMDL:Geometric Mean: **91%**Single Sample: **75%****Data:** 1998 and 2000 from CT DEEP targeted sampling efforts, 2012 TMDL Cycle**Single sample *E. coli* (colonies/100 mL) data from Station 69 on the Farm River (Segment 2) with annual geometric means calculated**

Station Name	Station Location	Date	Results	Wet/Dry	Geomean
69	Downstream of Totoket Road crossing	7/13/1998	1200	dry	1407* (91%)
69	Downstream of Totoket Road crossing	9/29/1998	1650*[†] (75%)	dry	
69	Downstream of Totoket Road crossing	10/16/2000	410	dry	NA
Shaded cells indicate an exceedance of water quality criteria [†] Average of two duplicate samples *Indicates single sample and geometric mean values used to calculate the percent reduction					

Wet and dry weather geometric mean values for all monitoring stations on the Farm River (Segment 2)

Station Name	Station Location	Years Sampled	Number of Samples		Geometric Mean		
			Wet	Dry	All	Wet	Dry
69	Downstream of Totoket Road crossing	1998, 2000	0	3	933	NA	933
Shaded cells indicate an exceedance of water quality criteria Weather condition determined from rain gage at Tweed KMMK station in New Haven, CT							

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